No. 83-196

IN THE

Supreme Court of the United States

OCTOBER TERM, 1983

WILLIAM D. RUCKELSHAUS, Administrator,
United States Environmental Protection Agency
Appellant,

vs.

MONSANTO COMPANY,
Appellee.

On Appeal From The United States District Court For The Eastern District of Missouri

BRIEF OF THE AMERICAN CHEMICAL SOCIETY, THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, THE AMERICAN INSTITUTE OF CHEMISTS, AND THE WEED SCIENCE SOCIETY OF AMERICA AS AMICI CURIAE IN SUPPORT OF APPELLEE

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PRELIMINARY STATEMENT

The American Chemical Society, The American Institute of Chemical Engineers, The American Institute of Chemists, and The Weed Science Institute of America submit this brief *amici curiae* in support of Appellee Monsanto Company. Both parties to this appeal have given said amici written consent to the filing of this brief. The original copies of said consents have been filed with the Clerk of this Court.

THE INTERESTS OF THE AMICI

The American Chemical Society (ACS) is incorporated by the United States Congress as a non-profit, membership, scientific, educational society composed of chemists and chemical engineers, and is exempt from the payment of federal income taxes under Section 501(c)(3) of the Internal Revenue Code of 1954, as amended.

As of December, 1983, the American Chemical Society consisted of more than 131,545 members. Its Federal Charter was granted in 1937 by an Act of the Congress. It replaced a New York State Charter, which had been effective since November 9, 1877.

Section 2 of the Act is as follows:

> Sec. 2. That the objects of the incorporation shall be to encourage in the broadest and most liberal manner the advancement of chemistry in all its branches; the promotion of research in chemical science and industry; the improvement of the qualifications and usefulness of chemists through high standards of professional ethics, education, and attainments; the increase and diffusion of chemical knowledge; and by its meetings, professional contacts, reports, papers, discussions, and publications, to promote scientific interests and inquiry, thereby fostering public welfare and education, aiding the development of our country's industries, and adding to the material prosperity and happiness of our people."

The American Chemical Society is a leading publisher of scientific journals in all phases of chemistry and chemical engineering. The Society holds regular scientific meetings at which chemists with common interests have an opportunity to exchange scientific information and maintain contacts. Representatives of the Society have appeared by invitation before Congress and other government bodies to advise on the effect of proposed actions on science, science policy, and the contributions of science to the public welfare.

The American Chemical Society represents a cross section of the whole of chemistry as a science in the United States. The institutional support of the science of chemistry is found in colleges and universities, scientific research institutions, the chemical industry, and government agencies. All are interdependent in the scientific and societal sense, and they are broadly interdependent economically.

Of particular concern to the ACS is the negative effect that a reversal of the decision of the District Court below would have on research and development in all aspects of the chemical industry. It would disrupt the classical procedures by which scientists seek to derive benefit from their work: to publish or patent; or to keep in confidence. ACS submits that if developers of complex chemical processes may be stripped of constitutional protection for technology they choose to keep secret, then there exists a grave threat to chemical research and development as it exists in this country today. It is a matter of serious concern to the American Chemical Society that the incentive and support which traditional trade secret protection has brought to our nation's technological strength should not be unnecessarily diminished.

As applied particularly to the agricultural chemical industry, ACS is concerned that world food production may be adversely affected if pesticide research and development are unneccessarily impaired. American agriculture, which is an extremely important sector of our national economy, will suffer substantially if pesticide research is inhibited. Further, the pesticide industry produces a very favorable balance of trade which will be jeopardized by a diminution in the research incentives of American pesticide producers.

In the view of the ACS the decision of this Court in this case can have an effect on chemical research for the years to come, not only on research on pesticidal chemicals, but also on the growth of the chemical industry; on chemistry programs at universities; and on the employment of chemists; as well as on the ability of chemistry and chemists to contribute in an optimum way to the public welfare. The Society appreciates this opportunity to express and explain its concerns.

The American Institute of Chemical Engineers (AIChE) is a scientific and educational organization consisting of approximately 54,000 members, and is exempt from federal taxation under Section 501(c)(3) of the Internal Revenue Code. The majority of AIChE members are fully qualified professional chemical engineers, employed in industry, government at all levels, and in academia.

AIChE's objectives are to advance chemical engineering in theory and in practice, to maintain high professional standards among its members, and to serve society, particularly where chemical engineering can contribute to the public interest. AIChE shares the same concerns as the American Chemical Society as set forth above.

The American Institute of Chemists (AIC) is a nonprofit scientific and educational organization composed of more than 5,000 senior practitioners of the chemical sciences, and is exempt from federal taxation under section 501(c)(6) of the Internal Revenue Code. AIC members are found in positions of responsibility in universities, research institutions, government agencies and in the chemical industry. AIC shares the same concerns as the American Chemical Society as set forth above.

The Weed Science Society of America (WSSA) is a scientific and educational organization composed of 3,861 members, and is exempt from federal taxation under Section 501(c)(3) of the Internal Revenue Code. Approximately one-half of WSSA's members work in the academic and public research sectors of agricultural chemistry, while the remainder are employed in industry.

WSSA's objectives are to: encourage and promote the development of knowledge concerning weed science; publish the results of meritorious research and other information of value pertaining to weed science; promote unity in education, legislation, regulation, terminology, and other matters pertaining to weeds; foster high standards in weed control educa-

tion, and encourage its acceptance as a major field of training; promote ethical conduct and good fellowship among its members; aid in the coordination of activities and cooperate with member weed control organizations, and cooperate with other societies and organizations with similar and related interests; and remain a scientific and educational organization without the objective of financial gain. WSSA shares the same concerns as the American Chemical Society as set forth above.

I. THE FORCED DISCLOSURE FOR ADVERSE PRIVATE USE OF PESTICIDE TRADE SECRETS WILL CAUSE A REDUCTION IN RESEARCH AND DEVELOPMENT IN THE APPLIED SCIENCES.

As a federally chartered scientific and educational organization, the ACS is gravely concerned about the consequences a reversal in this case would have upon our nation's economy, as well as the adverse consequences which would be suffered by the Society's individual members engaged in agricultural research and development. All of your amici share these concerns.

Pesticide development is vital to American agriculture. The superior production capability of the American farmer is in large measure dependent upon the continued availability of effective new agricultural chemicals. Moreover, there is a constant need for new and more effective pesticides because of constant development of immunities by agriculture's natural enemies. Research and development, therefore, are critical in the pesticide field.

Your amici are convinced that a reversal in this case will foster an economic climate which will substantially diminish research and development of new pesticides. Chemists and other scientists working in all aspects of pesticide research will become unemployed as a consequence. Pesticide producers can not be expected to continue to invest millions of dollars on product research and development unless adequate benefits can be achieved by the investor.

It is well established that chemical producers must expend millions of dollars and conduct many years of research and development in order to create new pesticide products. As the court below stated:

> A company's decision to develop pesticides requires it to make major commitments long before it can anticipate developing a commercial pesticide and even longer before it can expect any return on its investment. First, the company must synthesize, test and evaluate candidate pesticides typically for 4 to 8 years before it will identify a commercial candidate. It must then conduct extensive research for at least 6 additional years, including 2 years to obtain registration, before it can anticipate first marketing a product. Generally, a further 4 to 8 years will lapse before that product reaches a point where its costs of discovery, development and commercialization have been recovered. Second, the company must commit to the employment of a large scientific research group representing many disciplines, and to the acquisition of the necessary physical facilities and sophisticated equipment to conduct the intensive research required to assure some reasonable probability of success in discovering and commercializing a candidate pesticide. Third, any such company must usually commit to the expenditure of $5 million to $15 million annually for several years before it will develop a potential commercial pesticide candidate.

Jurisdictional Statement at 5a. Your amici are concerned that if the ability to protect secret technology is removed the American chemical industry will be unwilling to invest the vast funds and resources for research and development necessary to the creation of effective pesticides.

The 1982 Industry Profile Study of the National Agricultural Chemicals Association contains the most recent statistics concerning pesticide production, research and development. App. at 1a et. seq. Total pesticide research and development

expenditures were $527 million in 1982. App. at 3a. Research on new products accounted for 66% of the total figure. The search for additional uses for existing products accounted for 25% of the expenditure and 9% was spent for registration under FIFRA and product defense. *Id.* Yet in 1982 only thirteen new compounds were registered with the EPA. Ten of those received conditional registrations, while three received full registration. *Id.* These data reflect that for every new compound registered in 1982, pesticide producers were investing more than $26 million for new pesticide research.

In order to engage in innovative pesticide research, laboratories must be established and staffed with specialists to synthesize numerous compounds in an attempt to discover those which possess biological utility and commercial value. The discovery phase consists of extensive laboratory tests on these potential insecticides, bactericides, nematocides, herbicides, fungicides and rodenticides. Laboratory tests must be followed by small plot tests and subsequently large scale field evaluations. The discovery phase is followed by the development phase, which consists of residue testing to determine, often to parts per billion, whether residues remain in food or feed crops, water or soil. Toxicology studies must be conducted in order to assure that the compound is not hazardous to man or the environment. These extensive studies on laboratory animals are required to determine proper precautions in the production, packaging, transportation, storage, use and disposal of the product. A petition for tolerances and registration is then assembled and filed for review with the EPA.

The entire process of pesticide discovery, development and registration has become increasingly expensive, time consuming and risky over the years. If the Appellant's position is upheld and all data filed with the EPA must be turned over to competitors of the developer, the risk equation is further overbalanced. The elimination of trade secret protection for pesticide developers can only serve to discourage further innovation.

A. PRIOR DECISIONS OF THIS COURT HAVE EXPLICITLY RECOGNIZED THAT ELIMINATING PROPERTY RIGHTS AND PLACING INTELLECTUAL PROPERTY IN THE PUBLIC DOMAIN WILL RESULT IN DIMINISHED RESEARCH AND DEVELOPMENT

In *Kewanee Oil Co. v. Bicron Corp.*, 416 U.S. 470 (1974), this Court held that federal patent law does not pre-empt state trade secret protections. In so ruling, this Court recognized that:

> Trade secret law will encourage invention in areas where patent law does not reach, and will prompt the independent innovator to proceed with the discovery and exploitation of his invention. Competition is fostered, and the public is not deprived of the use of valuable, if not quite patentable information.

Id. at 485.

In *Dawson Chemical Co. v. Rohm & Hass Co.*, 448 U.S. 176 (1980), this Court judicially recognized the importance of protecting the extraordinary investment of chemical manufacturers in the development of "new use" patents on chemical processes.

> Development of new uses for existing chemicals is thus a major component of practical chemical research.
>
> It is extraordinarily expensive. It may take years of unsuccessful testing before a chemical having a desired property is identified, and it may take several years of further testing before a proper and safe method for using that chemical is developed.
>
> Under the construction of § 271(d) that petitioners advance, the rewards available to those willing to undergo the time, expense, and interim frustration of such practical research would provide at best a

> dubious incentive. Others could await the results of the testing and then jump on the profit bandwagon by demanding licenses to sell the unpatented, non-staple chemical used in the newly developed process.
>
> • • •
>
> *As a result, noninventors would be almost assured of an opportunity to share in the spoils, even though they had contributed nothing to the discovery. The incentive to await the discoveries of others might well prove sweeter than the incentive to take the initiative oneself.*

Id. at 221-22 (Emphasis added).

The analysis set forth above applies with equal force to both patent and trade secret protection. In both contexts, this Court has recognized the need for appropriate legal protections.

Your amici will not endeavor to improve upon Justice Blackmun's articulation of the importance of protecting chemical research, and the loss of incentive which will occur if the fruits of years of research are placed in the public domain. Your amici feel compelled to press their view that the confiscatory position taken by the EPA in this case will deter future scientific research in this country.

B. CHEMICAL INNOVATION IS IMPORTANT TO THE NATION

Research on chemical pesticides and their uses has made countless contributions to our way of life. Notable have been contributions to human health and the production of food. In the field of agricultural chemicals which includes insecticides, herbicides, fungicides, nematocides, and plant growth regulators there have been remarkable advances. Only a decade ago insect pest control required the use of highly persistent chemicals at rates of 1 to 3 pounds per acre. Today new chemicals, of greatly improved environmental safety, control major crop insects at rates ranging from 0.2 pound per acre to as low as 0.01 pound per acre. Selective herbicides have

changed the nature of agricultural labor and costs. Even so, in many parts of the world major portions of crops are destroyed by pests before harvest, and more is lost while the harvest is in storage or transit. Much remains to be done, and there seems little doubt that safer and more effective chemicals can be found to help meet the needs of the hungry world population.

Innovation is absolutely critical in the pesticide industry. The biological targets of pesticides are dynamic. Their extremely rapid reproductive cycles and their inherent adaptability allow them to develop resistance and outright immunity to existing pesticides. As a result there exists a constant need to develop new and more effective chemicals to combat the natural enemies of world agriculture. Yet the costs of such development continue to escalate.

In 1978, the American Chemical Society analyzed recent trends in research and development, innovation, and productivity in the United States, and offered recommendations for enhancing the technological strength of the United States. [1] The statement described the innovative process and its underlying economics:

> Industrial innovation is a complex process usually involving many steps and many factors. Generally the most common process starts with the discovery of a new fact or phenomenon resulting from a basic research program or occasionally from accidental observation. This is followed by an applied research program to find a use or an application of this discovery, or a completely unrelated research program to find a solution to an existing problem or need. Identification of a potential application is followed by a development process including, among other things, scale-up long-term testing, toxicity or safety evaluation, and market surveys. The final step is commercialization, which involves investment in a new plant, market development, and establishment of a distribution system.

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[1] *Innovation and Private Investment in R&D*, Chemical & Engineering News, April 30, 1979, at 36-44.

> The driving force for the whole innovation process is the expectation of a satisfactory return on invested capital. If any factor in the process increases the overall cost or lengthens the time from the basic discovery to successful commercialization of a product, the return on investment will be decreased and the investment will appear to be less attractive. If investors even perceive at any stage in the innovation process that the return on investment will not be sufficient to justify the risk involved, no innovation will result. . . . [2]

Future innovation is dependent upon the amount of investment capital which is generated by existing commercially successful products. In order for innovation to continue, it is essential that existing trade secrets be protected under the law.

C. AMERICAN CHEMICAL PRODUCERS WILL BE DISADVANTAGED RELATIVE TO FOREIGN COMPETITION

If the trade secret use and disclosure provisions of FIFRA are deemed to be constitutional by this Court, American chemistry and American chemists will be placed at a severe disadvantage relative to their foreign competitors. As the court below found:

> The use or consideration for or disclosure to any third party by defendant of plaintiff's data will irreparably injure plaintiff in the conduct of its business and will confer an immediate and substantial competitive advantage upon its competitors, including foreign government-owned pesticide producers, by eliminating the significant leadtime advantages enjoyed by plaintiff, by advancing significantly the state of such competitors' technology and by permitting the registration of their products, both in the United States and foreign countries, without their incurring the enormous expenditure of time and money for research and development which plaintiff has incurred.

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[2] *Id.* at 38.

Jurisdictional Statement at 25a.

Your amici feel strongly that the disclosure and use provisions of FIFRA will adversely affect our nation's technological strength. Foreign governments and industries enjoying the benefits of gratuitous trade secret information and possessing a great advantage in economic resources will reap substantial benefits at the expense of U.S. firms. The competitive advantage which foreign producers will gain thereby will result in lost opportunities and reduced employment in the chemical community in the United States.

D. PUBLIC DISCLOSURE OF TRADE SECRETS IS NOT NECESSARY TO ACHIEVE "PEER REVIEW"

The wholly speculative assertion made by Appellant that postdisclosure "peer review" of trade secret information will encourage research and enhance scientific progress is contrary to experience. Public interest environmental groups, the AFL-CIO and other amici supporting the Appellant do not conduct research. Peer review of scientific research is always done in private, prior to publication. Reviewers are fellow scientists, not competitors in the commercial market place. Peer review is an accepted scientific procedure, and the submission for publication of the work reviewed is at the discretion of the scientist-originator. The reviewer is not entitled to take the work of the originator as his own, for commercial gain in competition with the originator.

Moreover, the EPA Office of Pesticide Programs Hazard Evaluation Division (HED) performs exhaustive evaluations of test data. HED's four branches, toxicology, residue product chemistry, environment assessment and ecological effects, go far beyond "peer review" in performing their approval and acceptance function. Additionally, FIFRA § 25(d) authorizes the Scientific Advisory Panel to review the data requirements for registration and to conduct peer review in special cases when scientific advice is needed by EPA on pesticide issues. These reviews are conducted on a confidential basis with the recogni-

tion that the data under review are the property of the developer.

Your amici do not believe that public disclosure of trade secret complete test data will materially advance the scientific process, or contribute to the public welfare.

II. THE FIFTH AMENDMENT TO THE CONSTITUTION PROHIBITS THE TAKING OF SECRET TECHNOLOGY LIKE OTHER PROPERTY

In view of the vital importance of trade secret property in our technological society, your amici strongly urge this Court to uphold the rule that technological property is protected from confiscatory taking without just compensation under the Fifth Amendment to the United States Constitution.

There is clearly no social or economic utility in discouraging innovation. There is no redeeming public benefit in the provisions of FIFRA which are here at issue. Technological property is increasingly important to our national economy. Projections by the U.S. Department of Labor indicate that employment in high technology industries will increase faster than total employment between 1982-1995.[3] One need look no further than recent dramatic attempts at high technology industrial piracy to appreciate the value of trade secrets in the international economy. *E.g., IBM v. Hitachi*, No. 82 Civ. 4976 (N.D. Cal. 1982); *IBM v. Mitsubishi*, No. 82 Civ. 0396 (N.D. Cal. 1982) (disposition by consent decrees).

In view of the importance of trade secrets to our national economy in general, and to the chemical community in particular, your amici urge this Court to uphold the Appellee's position that trade secrets are constitutionally protected property under the Fifth Amendment.

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[3] V. Personik, *The Job Outlook through 1995: Industry & Employment Projections*, Monthly Labor Review, U.S. Department of Labor, Bureau of Labor Statistics (Nov. 1983), at 29. The B.L.S. has three different definitions of high-tech industries. "Under the broadest of the three definitions, high-tech industries account for 17 percent of all new jobs between 1982 and 1995; under the second definition, they account for 8 percent; while under the narrowest definition they represent slightly more than 3 percent." *Id.*

Conclusion

For the foregoing reasons, your amici urge this Court to affirm the judgment of the United States District Court for the Eastern District of Missouri.

Respectfully submitted,

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1982

INDUSTRY PROFILE SURVEY

NATIONAL AGRICULTURAL CHEMICALS ASSOCIATION

Ernst & Whinney
Washington, D.C.

INTRODUCTION FOR THE 1982 NACA INDUSTRY PROFILE STUDY

(Prepared by Industry Statistics Committee)

The 1982 Industry Profile Study is the tenth survey to be conducted by the Industry Statistics Committee at the request of the Board of Directors. The data were collected for this study by Ernst and Whinney, who have collected the data on all of the ten studies.

Questionnaires were completed by 39 member companies which include 36 who conducted research and development.

Sales Statistics (Schedules 1-4)

U.S. Pesticide Sales

Total U.S. pesticide sales (which includes U.S. sales of U.S. production and U.S. sales of non-U.S. production) were $4.2 billion in 1982, down $19 million or 0.5% compared to 1981. 1982 represented the first reduction in U.S. pesticide sales since the surveys were initiated ten years ago.

U.S. pesticide sales of U.S. production were $3.6 billion or 88% of total U.S. pesticide sales and represented a decline of $53 million or 1.4% from 1981.

U.S. pesticide sales of non-U.S. production increased by $35 million or 7.3% in 1982 to $510 million accounting for 12% of the total U.S. sales.

Herbicides

Total U.S. herbicide sales in 1982 were $2.9 billion compared to $2.8 billion in 1981, a 4% gain. Herbicide sales represented 69% (up 3%) of the total U.S. pesticide market in 1982.

Insecticides

Total U.S. insecticide sales were $862 million in 1982, a reduction of $142 million or 14% compared to 1981. U.S. insecticide sales account for 21% (down 3%) of total U.S. pesticide sales.

Non-U.S. Sales of U.S. Production

Non-U.S. sales of U.S. pesticide production were $1.26 billion in 1982. This compares to $1.25 billion in 1981, an increase of 1%. Non-U.S. Sales represented 26% of the total sales from U.S. production.

Research and Development Statistics (Schedules 5-9)

During 1982, 10 products received conditional registrations and 3 full registrations were reported.* This compares with 10 conditional and nine full product registrations in 1981. Of the 36 reporting member companies which conducted research and development, 17 compounds were submitted for a full label in 1982 compared to 14 compounds which were submitted in 1981. (Schedule 5A, page 7)

Research and development expenditures were $527 million in 1982, up $75 million or 16.6% from the 1981 spending level.

Research on new products accounted for 66% of the $527 million R&D expenditures. Product label expansion (uses on additional crops, additional weed or insect species, different application procedures, etc.) accounted for 25% of the expenditures. Reregistration and product defense accounted for the remaining 9%. (Schedule 6-A, page 9)

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* A registrant who satisfies all the data requirements of FIFRA receives a "full registration" for the product. If any of the data requirements are not fully satisfied, a "condition registration" may be issued, if the registrant agrees to develop and submit the required data, usually within a specified time period. A product that receives a full or conditional registration can be marketed by the registrant.

Over one-half of all R&D expenditures fell within the following three general categories: (Schedule 6-A, page 9)

Synthesis and Screening	24%
Field Plot Testing	19%
Process Development	13%

Herbicides accounted for 43% of all R&D expenditures, insecticides for 29% and fungicides 15%. These percentages were only slightly changed from 1981. (Schedule 6-A-1, page 13)

R&D expenditures as a percent of total U.S. sales and export sales for 1982 were 9.7%, up significantly from the 8.3% reported in 1981. (Schedule 7, page 17)

R&D costs, as a percent of sales, also vary considerably by size of company. In 1982 companies with sales under $50 million had R&D costs that were 21% of sales, companies with sales of $50-200 million had R&D costs that were 10% of sales and companies with sales exceeding $200 million had R&D costs that were 9% of sales.

Cost of rebutting RPAR actions by EPA, which declined 30% in 1981, (Schedule 10-A, page 23) decreased another 12% in 1982 and now represents less than 1% of the total R&D expenditures.

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Ernst & Whinney

1225 Connecticut Avenue, N.W.
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April 20, 1983

To Members of the
National Agricultural Chemicals Association

The Industry Statistics Committee, acting on behalf of the Association, engaged us to compile the NACA Industry Profile Study for Years 1981 and 1982.

The data shown are derived from amounts reported to us by the participants. Source data used to compile the report have not been audited by us. The individual reports were reviewed for obvious clerical errors and missing data and, where necessary, we contacted the reporting companies on questionable data.

If you have any questions in regard to any of the composite information, do not hesitate to call Ms. Barbara Guyon at 202/862-6042.

Very truly yours,

Attachment

IMPORTANT SURVEY INFORMATION

The following points should be noted with respect to the NACA Industry Profile Survey.

- Questionnaires were sent to all members of NACA. We received responses from thirty-nine (39) companies, thirty-six (36) of which reported research and development information. All questions were not applicable to all companies; hence, certain areas of the report contain tabulated responses of less than 39 companies as appropriately indicated.
- Of the 42 companies that are considered Basic Producers, 36 responded to this survey.
- Sales data are arrayed in composite form only, in order to avoid disclosure of individual company data. Research and development information is shown in composite form, and segregated by sales volume.
- To avoid disclosure of individual company information, data were not shown (in which case a (D) appears) or were combined in some areas of the report. If less than three companies reported in any category or one company had more than 80 percent of the total in a category, the figures were not shown or were combined with another category.
- The source documents used to compile this report will be destroyed when their statistical use has been completed. No one other than Ernst & Whinney personnel assigned to this engagement had access to individual company documents.
- No attempt was made to investigate the possibility of duplicate reporting for the number of active ingredients (No. of AI) on Schedules 2, 3 and 4.

SCHEDULE 1

PESTICIDE SALES

Composite Analysis of All Reporting Companies

	1981	1982	Percent Change
	(000)	(000)	
U.S. Sales of U.S. Production	$3,702,272	$3,649,096	−1.4
Non-U.S. Sales of U.S. Production	1,251,323	1,262,514	+0.9
U.S. Sales of Non-U.S. Production	475,787	510,368	+7.3
Total Sales	$5,429,382	$5,421,978	−0.1

SCHEDULE 2

U.S. SALES OF U.S. PRODUCTION OF PESTICIDES

Composite Analysis of All Reporting Companies

	1981			1982		
	Proprietary	Non-Proprietary	Total	Proprietary	Non-Proprietary	Total
Herbicides						
Sales Dollars (000)	1,910,340	576,438	2,486,778	1,982,238	558,377	2,540,615
Pounds AI (000)	371,262	217,092	588,354	364,351	191,540	555,891
No. of AI	54	38	92	60	41	101
Insecticides						
Sales Dollars (000)	577,626	274,182	851,808	502,600	247,381	749,981
Pounds AI (000)	77,832	103,281	181,113	55,767	81,822	137,589
No. of AI	33	45	78	31	49	80
Fungicides						
Sales Dollars (000)	171,025	31,376	202,401	152,381	33,792	186,173
Pounds AI (000)	36,510	23,262	59,772	32,523	20,284	52,807
No. of AI	18	31	49	18	36	54
Plant Growth Regulators						
Sales Dollars (000)	(D)	(D)	40,409	(D)	(D)	40,117
Pounds AI (000)	(D)	(D)	(D)	(D)	(D)	(D)
No. of AI	(D)	(D)	21	(D)	(D)	21
Nematicides						
Sales Dollars (000)	(D)	(D)	78,856	(D)	(D)	97,245
Pounds AI (000)	(D)	(D)	82,955	(D)	(D)	72,343
No. of AI	(D)	(D)	8	(D)	(D)	8
Miscellaneous						
Sales Dollars (000)	(D)	(D)	42,020	(D)	(D)	34,965
Pounds AI (000)	(D)	(D)	(D)	(D)	(D)	(D)
No. of AI	(D)	(D)	30	(D)	(D)	31
Total*						
Sales Dollars (000)	2,764,037	938,235	3,702,272	2,740,072	909,024	3,649,096
Pounds AI (000)	514,249	423,688	937,937	477,131	359,070	836,201
No. of AI	136	142	278	137	158	295
No. of Companies	29	30	36	29	30	36

(D) Not shown to avoid disclosure of individual company data.

* Includes data not shown above due to disclosure.

SCHEDULE 3

NON-U.S. SALES OF U.S. PRODUCTION OF PESTICIDES

Composite Analysis of All Reporting Companies

	1981			1982		
	Proprietary	Non-Proprietary	Total	Proprietary	Non-Proprietary	Total
Herbicides						
Sales Dollars (000)	430,304	159,311	589,615	373,697	216,251	589,948
Pounds AI (000)	103,217	86,458	189,675	90,296	73,977	164,273
No. of AI	48	27	75	46	26	72
Insecticides						
Sales Dollars (000)	297,930	123,037	420,967	303,889	142,765	446,654
Pounds AI (000)	39,229	58,883	98,112	30,090	62,107	101,197
No. of AI	33	29	62	27	33	60
Fungicides						
Sales Dollars (000)	206,607	6,315	212,922	170,907	21,911	192,818
Pounds AI (000)	(D)	(D)	40,091	31,902	8,251	40,153
No. of AI	18	13	31	17	13	30
Plant Growth Regulators						
Sales Dollars (000)	(D)	(D)	16,945	(D)	(D)	18,085
Pounds AI (000)	(D)	(D)	(D)	(D)	(D)	(D)
No. of AI	(D)	(D)	19	(D)	(D)	19
Nematicides						
Sales Dollars (000)	(D)	(D)	7,520	(D)	(D)	13,480
Pounds AI (000)	(D)	(D)	(D)	(D)	(D)	(D)
No. of AI	(D)	(D)	6	(D)	(D)	6
Miscellaneous						
Sales Dollars (000)	3,354	0	3,354	691	838	1,529
Pounds AI (000)	(D)	0	(D)	(D)	(D)	(D)
No. of AI	10	0	10	5	4	9
Total*						
Sales Dollars (000)	953,008	298,315	1,251,323	869,930	392,584	1,262,514
Pounds AI (000)	180,476	159,087	339,563	164,608	155,446	320,054
No. of AI	119	84	203	105	91	196
No. of Companies	26	25	31	25	24	31

(D) Not shown to avoid disclosure of individual company data.

* Includes data not shown above due to disclosure.

SCHEDULE 4

U.S. SALES OF NON-U.S. PRODUCTION OF PESTICIDES

Composite Analysis of All Reporting Companies

	1981			1982		
	Proprietary	Non-Proprietary	Total	Proprietary	Non-Proprietary	Total
Herbicides						
Sales Dollars (000)	249,143	18,229	267,372	298,349	25,308	323,657
Pounds AI (000)	(D)	(D)	49,223	(D)	(D)	57,186
No. of AI	14	9	23	13	11	24
Insecticides						
Sales Dollars (000)	120,740	27,498	148,238	76,383	35,562	111,945
Pounds AI (000)	13,021	7,429	20,450	10,348	5,802	16,150
No. of AI	16	7	23	10	13	23
Fungicides						
Sales Dollars (000)	(D)	(D)	(D)	(D)	(D)	62,072
Pounds AI (000)	(D)	(D)	(D)	(D)	(D)	(D)
No. of AI	(D)	(D)	(D)	(D)	(D)	17
Plant Growth Regulators						
Sales Dollars (000)	0	(D)	(D)	0	(D)	(D)
Pounds AI (000)	0	(D)	(D)	0	(D)	(D)
No. of AI	0	(D)	(D)	0	(D)	(D)
Nematicides						
Sales Dollars (000)	0	(D)	(D)	0	(D)	(D)
Pounds AI (000)	0	(D)	(D)	0	(D)	(D)
No. of AI	0	(D)	(D)	0	(D)	(D)
Miscellaneous						
Sales Dollars (000)	(D)	0	(D)	(D)	0	(D)
Pounds AI (000)	(D)	0	(D)	(D)	0	(D)
No. of AI	(D)	0	(D)	(D)	0	(D)
Total*						
Sales Dollars (000)	418,810	56,977	475,787	428,500	81,868	510,368
Pounds AI (000)	64,657	21,024	85,681	61,830	32,916	94,746
No. of AI	45	24	69	38	31	69
No. of Companies	11	13	17	10	15	18

(D) Not shown to avoid disclosure of individual company data.

* Includes data not shown above due to disclosure.

SCHEDULE 5-A

RESEARCH AND DEVELOPMENT EXPENDITURES, SCREENING AND PRODUCT REGISTRATION

Composite Analysis of All Reporting Companies

		Number Reporting*	Year 1981	Year 1982	Percent Change
I.	Total R&D Expenditures	36	$451,929,000	$526,904,000	+ 16.6
II.	Total Compounds Screened	27	109,329	119,717	+ 9.5
III.	Number of New Products *Registered*:				
	Tolerance Products:				
	Full Registration	6	7	2	
	Conditional Registration	9	7	8	
	Non-Tolerance Products:				
	Full Registration	3	2	1	
	Conditional Registration	4	3	2	
IV.	R&D Expenditures (excluding synthesis and screening) associated with obtaining first full registration	9	$8,819,000**	$ 15,045,000***	
V.	Number of Compounds *submitted* for first full registration:				
	Tolerance Products	10	11	10	
	Non-Tolerance Products	7	3	7	

	Average Elapsed Time Per Product			
	Full Registration		Conditional Registration	
	1981	1982	1981	1982
A. Elapsed time from discovery to first full registration (months)	70	108	51	72
B. Elapsed time from first submission for temporary or experimental registration to commercial registration (months)	34	36	23	14
C. Elapsed time from submission to granting of commercial registration (months)	23	24	11	15

* Number of companies reporting in 1981 and 1982.

** Expenditures for nine products receiving first full registration.

*** Expenditures for three products receiving first full registration.

SCHEDULE 5-B

RESEARCH AND DEVELOPMENT EXPENDITURES, SCREENING AND PRODUCT REGISTRATION

Composite Analysis by Size of Company

	Number Reporting*	1981	1982	Percent Change
1982 Sales Volume Under $50,000,000				
I. Total R&D Expenditures	17	$45,569,000	$45,189,000	-0.8
II. Total Compounds Screened	9	6,861	10,039	+46.3
III. Number of New Products Registered:				
Tolerence Products:				
Full Registration	2	5	0	
Conditional Registration	5	6	5	
Non-Tolerance Products:				
Full Registration	2	1	1	
Conditional Registration	1	2	0	
1982 Sales Volume $50,000,000-$200,000,000				
I. Total R&D Expenditures	8	$81,866,000	$101,629,000	+24.1
II. Total Compounds Screened	8	29,468	32,236	+9.4
III. Number of New Products Registered:				
Tolerance Products:				
Full Registration	2	1	1	
Conditional Registration	2	1	1	
Non-Tolerance Products:				
Full Registration	0	0	0	
Conditional Registration	0	0	0	
1982 Sales Volume Over $200,000,000				
I. Total R&D Expenditures	11	$324,494,000	$380,086,000	+17.1
II. Total Compounds Screened	10	73,000	77,442	+6.1
III. Number of New Products Registered:				
Tolerance Products:				
Full Registration	2	1	1	
Conditional Registration	2	0	2	
Non-Tolerance Products:				
Full Registration	1	1	0	
Conditional Registration	3	1	2	

* Number of companies reporting in 1981 and 1982.

SCHEDULE 6-A

PESTICIDE RESEARCH AND DEVELOPMENT EXPENDITURES BY TYPE AND REASON

Composite Analysis of All Reporting Companies

1982

Type of Expenditure	Reason for Expenditure: New Product ($000)	Product Expansion ($000)	Reregistration & Product Defense ($000)	Total ($000)	Percent of Total
Synthesis	52,253		3,879A	56,132	11
Screening					
Primary	26,868		2,583A	29,451	5
Secondary	36,736		3,538A	40,274	8
Subtotal	115,857	9,167	833	125,857	24
Field Plot Testing	47,354	47,095	3,669	98,118	19
Toxicology:					
Mammalian	25,859	10,083	9,340	45,282	9
Environmental/Wildlife	3,484	915	1,249	5,648	1
Metabolism	8,202	5,457	4,358	18,017	3
Environmental Chemistry	3,121	3,912	2,355	9,388	2
Residue Analysis	9,747	8,159	5,803	23,709	4
Formulation Development	17,875	14,129	2,564	34,568	6
Process Development	51,110	14,344	4,740	70,194	13
Registration	3,870	6,477	3,926	14,273	3
Administration/Support	21,860	8,562	2,687	33,109	6
Cooperative Expenditures	1,733	797	71	2,601	1
All Other Expenditures	36,269B	4,537	5,334	46,140	9
Total	346,341	133,634	46,929	526,904	
Percent	66	25	9		100

Total 1981 R&D Expenditures: $451,929,000

A-Combined to avoid disclosure of individual company data.
B-Includes Other Basic Research Expenditures: $20,897,000

Number of Participants: 36

SCHEDULE 6-B

PESTICIDE RESEARCH AND DEVELOPMENT EXPENDITURES BY TYPE AND REASON

Composite Analysis by Size of Company

1982 Sales Volume Under $50,000,000

Type of Expenditure	Reason for Expenditure: New Product ($000)	Product Expansion ($000)		Reregistration & Product Defense ($000)	Total ($000)	Percent of Total
Synthesis	Note: Information in this section is not shown to avoid disclosure of individual company data.				4,208	9
Screening:						
Primary					1,590	4
Secondary					1,313	3
Subtotal					7,111	16
Field Plot Testing	6,731	4,826		846	12,403	27
Toxicology:						
Mammalian	2,643	597		428	3,668	8
Environmental/Wildlife	460	85		238	783	2
Metabolism	630		71A		701	2
Environmental Chemistry	268	67		42	377	1
Residue Analysis	1,085	977		172	2,234	5
Formulation Development	1,654		1,285A		2,939	7
Process Development	1,385		636A		2,021	4
Registration	704	736		152	1,592	3
Administration/Support	4,942	2,030		743	7,715	17
Cooperative Expenditures / All Other Expenditures	9,804A,B,C		952A,B		3,645A	8
Total	30,306	11,874		3,009	45,189	
Percent	67	26		7		100

Total 1981 R&D Expenditures: $45,569,000

A—Combined to avoid disclosure of individual company data.

B—Includes Subtotal for Synthesis and Screening.

C—Includes other Basic Research Expenditures.

Number of Participants: 17

SCHEDULE 6-C

PESTICIDE RESEARCH AND DEVELOPMENT EXPENDITURES BY TYPE AND REASON

Composite Analysis by Size of Company

1982 Sales Volume $50,000,000—$200,000,000

Type of Expenditure	Reason for Expenditure: New Product ($000)	Product Expansion ($000)	Reregistration & Product Defense ($000)	Total ($000)	Percent of Total
Synthesis				8,472	8
Screening:	Note: Information in this section				
Primary	is not shown to avoid disclosure			3,334	3
Secondary	of individual company data.			5,562	6
Subtotal				17,368	17
Field Plot Testing	8,902	14,481	1,014	24,397	24
Toxicology:					
Mammalian	4,071	2,148	4,091	10,310	10
Environmental/Wildlife	501	209	336	1,046	1
Metabolism	1,125	1,583	668	3,376	3
Environmental Chemistry	768	1,030A		1,798	2
Residue Analysis	2,547	2,786	1,213	6,546	6
Formulation Development	2,477	2,345A		4,822	5
Process Development	9,460	1,967A		11,427	11
Registration	861	2,145	1,918	4,924	5
Administration/Support	3,163	2,952	537	6,652	7
Cooperative Expenditures	0	2,080A,B		8,963A	9
All Other Expenditures	24,251B,C				—
Total	58,126	32,998	10,505	101,629	
Percent	57	33	10		100

Total 1981 R&D Expenditures: $81,866,000

A—Combined to avoid disclosure of individual company data.
B—Includes Subtotal for Synthesis and Screening.
C—Includes Other Basic Research Expenditures.

Number of Participants: 8

SCHEDULE 6-D

PESTICIDE RESEARCH AND DEVELOPMENT EXPENDITURES BY TYPE AND REASON

Composite Analysis by Size of Company

1982 Sales Volume Over $200,000,000

Type of Expenditure	Reason for Expenditure: New Product ($000)	Product Expansion ($000)		Reregistration & Product Defense ($000)	Total ($000)	Percent of Total
Synthesis					43,452	11
Screening:	Note: Information in this section					
Primary	is not shown to avoid disclosure				24,527	7
Secondary	of individual company data.				33,399	9
Subtotal					101,378	27
Field Plot Testing	31,721	27,788		1,809	61,318	16
Toxicology:						
Mammalian	19,145	7,338		4,821	31,304	8
Environmental/Wildlife	2,523	621		675	3,819	1
Metabolism	6,447	3,829		3,664	13,940	4
Environmental Chemistry	2,085		5,128A		7,213	2
Residue Analysis	6,115	4,396		4,418	14,929	4
Formulation Development	13,744	10,619		2,444	26,807	7
Process Development	40,265	11,894		4,587	56,746	15
Registration	2,305	3,596		1,856	7,757	2
Administration/Support	13,755	3,580		1,407	18,742	5
Cooperative Expenditures	119,804A,B,C		17,707A,B		36,133A	9
All Other Expenditures						
Total	257,909	88,762		33,415	380,086	
Percent	68	23		9		100

Total 1981 R&D Expenditures: $324,494,000

A—Combined to avoid disclosure of individual company data.
B—Includes Subtotal for Synthesis and Screening.
C—Includes Other Basic Research Expenditures.

Number of Participants: 11

SCHEDULE 6-A-1

RESEARCH AND DEVELOPMENT EXPENDITURES BY PRODUCT CATEGORIES

Composite Analysis of All Reporting Companies

1982

Product	Reason for Expenditure: New Product ($000)	Product Expansion ($000)	Reregistration & Product Defense ($000)	Total ($000)	Percent of Total	Percent of Sales
Herbicides	140,227	66,432	22,461	229,120	43	4.2
Insecticides	99,069	38,935	12,187	150,191	29	2.8
Fungicides	53,741	18,427	7,028	79,196	15	1.5
Plant Growth Regulators	35,438	3,062	1,608	40,108	8	0.7
Nematicides	5,490	2,678	1,775	9,943	2	0.2
Miscellaneous	12,376	4,100	1,870	18,346	3	0.3
Total	346,341	133,634	46,929	526,904	100	9.7

Number of Participants: 36

SCHEDULE 6-B-1

RESEARCH AND DEVELOPMENT EXPENDITURES BY PRODUCT CATEGORIES

Composite Analysis by Size of Company

1982 Sales Volume Under $50,000,000

Product	Reason for Expenditure: New Product ($000)	Product Expansion ($000)	Reregistration & Product Defense ($000)	Total ($000)	Percent of Total	Percent of Sales
Herbicides	A	A	A	11,670	26	5.5
Insecticides	16,053	3,717	1,063	20,833	46	9.9
Fungicides	3,284	2,694	854	6,832	15	3.2
Plant Growth Regulators	A	A	A	2,851	6	1.4
Nematicides	A	A	A	122	0	0.1
Miscellaneous	10,969A	5,463A	1,092A	2,881	7	1.4
Total	30,306	11,874	3,009	45,189	100	21.5

A—Combined to avoid disclosure of individual company data.

Number of Participants: 17

SCHEDULE 6-C-1

RESEARCH AND DEVELOPMENT EXPENDITURES BY PRODUCT CATEGORIES

Composite Analysis by Size of Company

1982 Sales Volume $50,000,000-$200,000,000

	Reason for Expenditure					
Product	New Product ($000)	Product Expansion ($000)	Reregistration & Product Defense	Total ($000)	Percent of Total	Percent of Sales
Herbicides	A	A	A	46,183	45	4.5
Insecticides	8,263	6,730	2,461	17,454	17	1.7
Fungicides	9,849	7,911	4,170	21,930	22	2.1
Plant Growth Regulators	A	A	A	6,120	6	0.6
Nematicides	2,341	0	0	2,341	2	0.2
Miscellaneous	37,673A	18,357A	3,874A	7,601	8	0.7
Total	58,126	32,998	10,505	101,629	100	9.8

A—Combined to avoid disclosure of individual company data.
Number of Participants: 8

SCHEDULE 6-D-1
RESEARCH AND DEVELOPMENT EXPENDITURES BY PRODUCT CATEGORIES

Composite Analysis by Size of Company

1982 Sales Volume Over $200,000,000

Product	Reason for Expenditure: New Product ($000)	Product Expansion ($000)	Reregistration & Product Defense ($000)	Total ($000)	Percent of Total	Percent of Sales
Herbicides	106,033	47,240	17,994	171,267	45	4.1
Insecticides	74,753	28,488	8,663	111,904	30	2.7
Fungicides	40,608	7,822	2,004	50,434	13	1.2
Plant Growth Regulators	A	A	A	31,137	8	0.7
Nematicides	A	A	A	7,480	2	0.2
Miscellaneous	36,515A	5,212A	4,754A	7,864	2	0.2
Total	257,909	88,762	33,415	380,086	100	9.1

A—Combined to avoid disclosure of individual company data.
Number of Participants: 11

SCHEDULE 7

RELATIONSHIP BETWEEN PESTICIDE RESEARCH AND DEVELOPMENT EXPENDITURES AND TOTAL SALES BY SALES VOLUME

	1981 SALES VOLUME			
	Under $50,000,000	$50,000,000-$200,000,000	Over $200,000,000	All Companies
Total R&D as a Percent of Total Sales*	20.4%	10.2%	7.4%	8.3%
Median Percent	10.0%	8.8%	7.3%	8.9%
Number of Participants	17	7	12	36

	1982 SALES VOLUME			
	Under $50,000,000	$50,000,000-$200,000,000	Over $200,000,000	All Companies
Total R&D as a Percent of Total Sales*	21.5%	9.9%	9.1%	9.7%
Median Percent	14.7%	8.4%	10.3%	10.4%
Number of Participants	17	8	11	36

* Based on companies reporting both R&D and sales.

SCHEDULE 8

PESTICIDE RESEARCH AND DEVELOPMENT EXPENDITURES AS A PERCENT OF SALES

Type of Expenditure	Percent of Total 1982 Sales*			
	Sales Under $50,000,000	Sales $50,000,000-$200,000,000	Sales Over $200,000,000	All Companies
Total Synthesis and Screening	3.4	1.7	2.4	2.3
Field Plot Testing	5.9	2.4	1.5	1.8
Toxicology				
Mammalian	1.7	1.0	0.7	0.8
Environmental/ Wildlife	0.4	0.1	0.1	0.1
Metabolism	0.3	0.3	0.3	0.3
Environmental Chemistry	0.2	0.2	0.2	0.2
Residue Analysis (Includes methods development)	1.1	0.6	0.4	0.4
Formulation Development	1.4	0.5	0.6	0.6
Process Development	1.0	1.1	1.4	1.3
Registration	0.8	0.5	0.2	0.3
Administration/Support	3.6	0.6	0.4	0.6
Cooperative Expenditures	A 1.7	A 0.9	A 0.9	0.1
All Other Expenditures (Includes Other Basic Research)	—	—	—	0.9
TOTAL	21.5	9.9	9.1	9.7

* Based on companies reporting both R&D and sales.

A—Combined to avoid disclosure of individual company data.

Number of Participants:	17	8	11	36

SCHEDULE 9-A

PERSONNEL IN PESTICIDE RESEARCH AND DEVELOPMENT
Composite Analysis of all Reporting Companies

United States and International*	Number of Employees 1981	Number of Employees 1982	Percent Change
Level of Education			
Doctor's Degree.....	1,477	1,631	+ 10.4
Master's Degree.....	738	785	+ 6.4
Bachelor's Degree....	1,249	1,374	+ 10.0
Other Training & Nontechnical.....	2,186	2,124	- 2.8
TOTAL U.S. & INTERNATIONAL.....	5,650	5,914	+ 4.7

* International personnel are those whose efforts are directed in support of domestic sales of pesticide products manufactured in the U.S. and in support of export sales of pesticides manufactured in the U.S.

Number of Participants: 36

SCHEDULE 9-B

PERSONNEL IN PESTICIDE RESEARCH AND DEVELOPMENT

Composite Analysis by Size of Company
1982 Sales Volume Under $50,000,000

United States and International*	Number of Employees 1981	Number of Employees 1982	Percent Change
Level of Education			
Doctor's Degree.....	119	122	+2.5
Master's Degree.....	112	112	0.0
Bachelor's Degree....	164	171	+4.3
Other Training & Nontechnical.....	173	162	-6.4
TOTAL U.S. & INTERNATIONAL.....	568	567	-0.2

* International personnel are those whose efforts are directed in support of domestic sales of pesticide products manufactured in the U.S. and in support of export sales of pesticides manufactured in the U.S.

Number of Participants: 17

SCHEDULE 9-C

PERSONNEL IN PESTICIDE RESEARCH AND DEVELOPMENT

Composite Analysis by Size of Company

1982 Sales Volume $50,000,000—$200,000,000

United States and International*	Number of Employees 1981	Number of Employees 1982	Percent Change
Level of Education			
Doctor's Degree.....	281	305	+ 8.5
Master's Degree.....	184	193	+ 4.9
Bachelor's Degree....	292	307	+ 5.1
Other Training & Nontechnical.....	295	312	+ 5.8
TOTAL U.S. & INTERNATIONAL.....	1,052	1,117	+ 6.2

* International personnel are those whose efforts are directed in support of domestic sales of pesticide products manufactured in the U.S. and in support of export sales of pesticides manufactured in the U.S.

Number of Participants: 8

SCHEDULE 9-D

PERSONNEL IN PESTICIDE RESEARCH AND DEVELOPMENT

Composite Analysis by Size of Company
1982 Sales Volume Over $200,000,000

United States and International*	Number of Employees 1981	Number of Employees 1982	Percent Change
Level of Education			
Doctor's Degree.....	1,077	1,204	+11.8
Master's Degree.....	442	480	+ 8.6
Bachelor's Degree....	793	896	+13.0
Other Training & Nontechnical.....	1,718	1,650	- 4.0
TOTAL U.S. & INTERNATIONAL.....	4,030	4,230	+ 5.0

* International personnel are those whose efforts are directed in support of domestic sales of pesticide products manufactured in the U.S. and in support of export sales of pesticides manufactured in the U.S.

Number of Participants: 11

SCHEDULE 10

COST OF REBUTTING RPAR ACTIONS BY EPA
Composite Analysis of All Reporting Companies

	1981 ($000)	1982 ($000)	Percent Change
Research Development Expenditures.....	3,688	2,856	-22.6
Other Direct Costs.....	1,128	1,368	+21.3
TOTAL.....	4,816	4,224	-12.3

Number of Participants: 19

SCHEDULE 11

PAYMENTS TO COOPERATIVE RESEARCH AND DEVELOPMENT PROGRAMS*

Composite Analysis of All Reporting Companies

	1981	1982	Percent Change
	($000)	($000)	
Lump Sum Payments.....	1,976	1,949	- 1.4
Other Costs	373	412	+10.5
TOTAL.....	2,349	2,361	+ 0.5

Number of Participants: 12

* To develop or acquire data in response to EPA re-registration or data call-in programs.